

Proceedings of the Iowa Academy of Science

Volume 64 | Annual Issue

Article 91

1957

A Case of Gila Monster Poisoning with a Summary of Some Previous Accounts

Martin L. Grant
Iowa State Teachers College

L. J. Henderson
Iowa State Teachers College

Let us know how access to this document benefits you

Copyright ©1957 Iowa Academy of Science, Inc.

Follow this and additional works at: <https://scholarworks.uni.edu/pias>

Recommended Citation

Grant, Martin L. and Henderson, L. J. (1957) "A Case of Gila Monster Poisoning with a Summary of Some Previous Accounts," *Proceedings of the Iowa Academy of Science*, 64(1), 686-697.

Available at: <https://scholarworks.uni.edu/pias/vol64/iss1/91>

This Research is brought to you for free and open access by the Iowa Academy of Science at UNI ScholarWorks. It has been accepted for inclusion in Proceedings of the Iowa Academy of Science by an authorized editor of UNI ScholarWorks. For more information, please contact scholarworks@uni.edu.

A Case of Gila Monster Poisoning with a Summary of Some Previous Accounts

By MARTIN L. GRANT AND L. J. HENDERSON

Since published accounts of the effects of Gila monster (*Heloderma suspectum* Cope) bites are variable and conflicting, due undoubtedly to the many uncontrolled factors involved, it has seemed appropriate to put on record the details of one which was observed under unusually favorable circumstances. In this instance the first author was the patient, or experimental animal, or victim, depending on the point of view, and the second author was the attending physician. They tried to play the additional part of impartial observers, and, if a built-in bias is to be detected, it can be blamed on the difficulty of separating the several roles involved.

A. DESCRIPTION OF THE INCIDENT

The Gila monster in question (Fig. 1) was a normal-sized adult,



Figure 1. The Gila monster responsible for the bite.

which had been in captivity at Iowa State Teachers College for seventeen months. The animal was 47.3 cm. long, including a 15-cm.

tail, and weighed 850 grams. The mazimum width of the three main body parts was: head 5.2 cm., trunk 9 cm., and tail 3.7 cm.

For a period of twenty years, off and on, examples of this species of lizard had been kept for demonstration in the college zoo. On only one previous occasion had any of them attempted to bite a person, as far as known. At that time the handler picked it up without noticing that the animal was asleep, and it lunged out and snapped without even opening its eyes. Of course, it missed the person's hand. In fact, this species had always seemed the ideal animal to illustrate the characteristics of lizards, due to its large size, relatively attractive appearance, availability, and sluggish and docile disposition when cool and well-fed (Fig. 2).

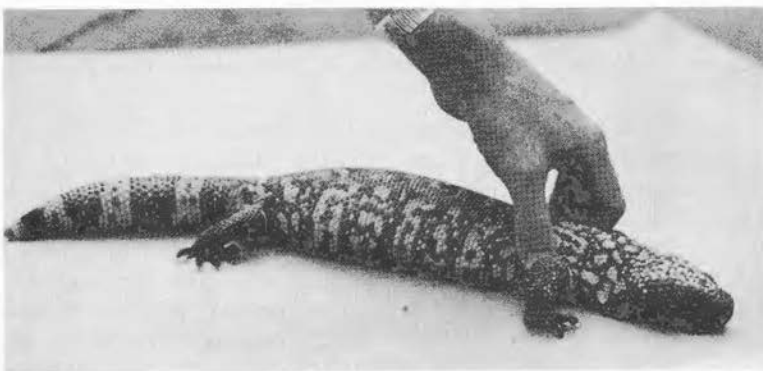


Figure 2. Gila monster in resting position.

On the present occasion, though it did not occur to the victim at the time, the animal had not been handled for about five months, and probably much of its conditioning to accept passive manipulation had worn off. Pure carelessness, however, lulled by many years of security, was responsible for the attack. About twenty children had gathered around the cage in such a way that the demonstrator, rather than move the majority of the class, rather foolishly and awkwardly reached over into the cage from the far side, and, at the time his hand contacted the animal, could not see it clearly. The result was that he picked it up about the middle of the body, instead of just under the fore legs as was the usual procedure. Thus, as the monster was being lifted out of the cage, it was easily able to swing its head around and clamp its jaws shut on the radial surface of the middle joint of the right thumb.

Gila monsters are notorious for the tenacity of their grip, and this one was no exception to the rule. It twisted its head around to an upside-down position, twisting, but not tearing, the skin in the process. With the left hand and the free fingers of the right, the victim twice tried to loosen the jaws, unsuccessfully. What he would

have given for a simple screwdriver at that moment! After a slight pause for breath, he tried again, and this time separated the jaws very slightly, such that most of the teeth were freed enough to permit tearing the head of the animal off from the thumb, leaving a modicum of skin laceration.

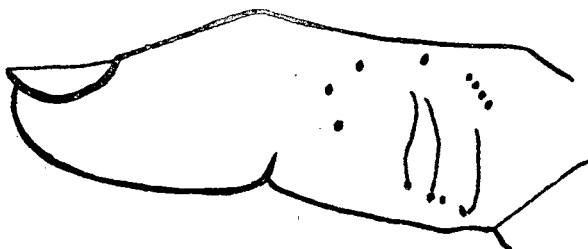


Figure 3. Radial aspect of right thumb, showing the incisions and lacerations produced by the Gila monster's teeth.

Much later, a close examination of the wound (Fig. 3) showed a neat semicircle, 15 mm. in diameter, of the marks of eight front teeth towards the dorsal surface of the thumb, and the incisions of four teeth, in an arc, of the left anterior part of the lower jaw. Apparently the lower right teeth had not engaged, due to the angle of the animal's head, and the curvature of the bitten surface. The maximum distance between the marks of the teeth of the two jaws was 17 mm. Between these two arcs of marks were three diagonal gashes, connected to the incisions of the lower teeth, indicating most of them had not been released by the lever action of the fingers when the monster's head was removed from the thumb.

Bleeding began after about ten seconds, and was quite profuse. The victim walked from the Vivarium to his office in the building across the street, washed the blood off, applied a gauze pad by means of an adhesive strip, then returned to continue the demonstration for the students. After several minutes, however, bleeding became so vigorous that it rinsed the adhesive loose. The class was dismissed, and the patient walked the half-block to the College Health Service, where additional temporary measures were taken. Finally, he decided to take it more seriously, returned to his office, drove the two miles home, picked up his wife, who drove him a half-mile more to Dr. Henderson's office, and hospitalization for 38 hours followed. Recovery was rapid and complete.

B. THE CLINICAL PICTURE

The patient was 50 years old, weighed 175 pounds, had had no diseases that, as far as known, might have influenced the toxemia, had led an active life, smoked regularly, drank about once a month, and had no known allergies other than to horse serum.

Oct. 15, 1956, 4:25 p. m. The Gila monster bit the patient. Application of small dry compress, after washing, was not sufficient to stop the bleeding. No suction was applied, nor incisions made, because of the profuse bleeding, uncertainty as to the actual toxicity of the venom, and lack of conviction as to their value with such a superficial wound. The pain seemed equivalent to what would accompany an uncomplicated wound of that size.

4:35 p. m. At the Health Service the wound was well washed with soap and water. Practically no swelling was evident. A large dressing was applied to the whole hand. Some sweating and mild vertigo was treated by inhalation of ammonia, and by lying down for a few minutes.

5:00 p. m. At Dr Henderson's office the dressing was removed. A hard edema involved the whole thumb and second metacarpal region, slightly painful to the touch. Temperature was 98.6°; during the two-day period it ranged from 97.8° (at 6:00 a.m.) to 98.8°. Pulse was 88; this similarly varied from 70 (6:00 a. m.) to 88. Blood pressure was 142/80. The heart had normal rhythm, with no murmurs nor enlargements. Respiration was 16; it varied later from 16-20. Bloody serum exuded from the puncture wounds. A tight tourniquet was applied 5 cm. proximal to the wrist, and maintained until 11:00 p. m., with 3-minute releases every 15-20 minutes. Dr. Henderson called an internist for information, and also the Mayo Clinic, but no additional suggestions were supplied. A rapid perusal of all the available literature similarly gave little help. Antivenin is not available, since Tyler's work (1946, 1956) on the production of auto-antivenin in *Heloderma* has apparently not been fully followed up.

6:00 p. m. Entered Sartori Hospital, Cedar Falls. The swelling had reached the tourniquet on the radial side of the hand. The fingers and wrist were stiff, probably due to the swelling of the tissues rather than to the direct effect of the venom. Pain and discomfort were slight, and were apparently largely due to the mechanical punctures and skin lacerations, and to the tourniquet. Blood pressure was taken every half-hour until 9:00 p. m., then every hour until 7:00 a. m., then every two hours until discharge from the hospital. The pressure fluctuated within the ranges 110-156/76-96. Other blood data: RBC 4,660,000; hemoglobin 90%; WBC 8,100; stab 5%, segm. 62%, lymphocytes 33%, no other types of white cells. Ilotycin, 250 mg. every four hours until discharge (10 doses), was taken to suppress infection, of which there never appeared any indication. Tetanus antitoxin was not used, because of susceptibility to horse serum. A warm wet compress was loosely applied, and, with frequent renewals, kept in place for the duration of hospitalization. Cryotherapy, as advocated by Stahnke (1953), was not used, in view of Shannon's (1956a, b) strong recommendations to the contrary.

11:00 p. m. Edema now extended through the entire metacarpal region and wrist up to the tourniquet. The band was loosened, such that only the subcutaneous circulation was shut off, and left that way without adjustment for the rest of the night.

Oct. 16. Two urinalyses were made during the early and late morning, with identical results: SG 1.025, pH 6.5-6.7, color straw; pus and squamous epithelium cells rare; no albumin, sugar, nor occult blood.

7:00 a. m. Edema had spread through all the fingers, but was still confined proximally by the tourniquet. The hand and lower wrist were about twice their normal volume. No tenderness or swelling was detected elsewhere, e.g., in the axillary lymph nodes. The tourniquet was removed, following which the edema extended slowly up the arm, greater on the dependent (flexor) surface, reaching its ultimate point about two inches above the elbow at about 4:00 p. m. The patient was permitted to walk about somewhat.

9:00 a. m. The hand was softer, not so tender. Blood data: RBC 4,450,000; hemoglobin 95%; WBC 8,100; basophiles 1%, stab 3%, segm. 49%, lymphocytes 45%, monocytes 2%.

3:00 p. m. The swelling had abated considerably, and it was now possible to use the hand for simple functions such as eating.

Oct. 17, 9:00 a. m. Edema was reduced, such that the hand size was about 10% above normal. The patient was discharged, walked the two blocks home, and, with several necessary periods of rest, was able to do a half-day's desk work.

Oct. 18. Edema entirely gone. Oct. 19: The dorsal metacarpal region was still tender to the touch. Oct. 21: The soreness was now restricted to the dorsal surface of the first and second metacarpals, and the middle segment of the thumb (the site of the bite) with its adjacent joints. This tenderness gradually disappeared over the course of several days. Six months later it took very close inspection to find the slight red marks indicating the site of the wound. There was no scar tissue.

To sum up the symptoms: (1) edema was severe; (2) there was essentially no pain, other than that due to the actual lesions of the skin, and the discomfort from the impaired circulation accompanying the use of the tourniquet; (3) systemic effects were largely confined to the first shock and (possibly) anxiety effects, and a general weakness during convalescence; (4) the slight lymphocyte increase (33% to 45%) and neutrophile decrease (67% to 52%) did not indicate toxemia; (5) specifically, there was little, if any, neurotoxicity, since there were no appreciable parathesias, and no respiratory or cardiac symptoms, though the variation in systolic pressures might indicate some vasopressor effect; (6) there was no hemolytic effect, since the red cell count and hemoglobin percentage remained constant and there was no evidence of hemoglobinuria; and (7) all other effects

reported by various Gila monster victims were absent, e.g., cyanosis, nausea, vomiting, fever, dyspnea, dysphonia, paralysis, and swelling of the tongue. The size and rapidity of the swelling indicated clearly that a certain amount of venom had been absorbed, but there is, of course, no way to estimate the quantity.

The authors feel that they would not use a tourniquet in a similar future incident, since there was here little more than local toxemia. Fillmore (1941) showed, in connection with snake poisoning, and Shannon (1956a, b) has further discussed the fact that passage of the venom generally occurs only through the subcutaneous tissue spaces. This is a relatively slow process, and the impression was that the discomfiture of the tourniquet, while not in itself very serious, was greater than that of the additional edema that probably would have occurred without the tourniquet's use. It is not known if the total edema would have been greater, but it surely would have spread through the same area more rapidly. This judgment, as to the needlessness of the tourniquet where little, or weak, venom has been introduced, depends on two assumptions: (1), with reference to the present patient, that allergic sensitivity to the venom would not have developed, and (2), with reference to other individuals, that there would be little individual difference in people in reaction to the venom. While these assumptions may seem reasonable, for neither of them is there any evidence.

The Gila monster apparently suffered no ill effects from the encounter, quite different from the account given by Edwards (1924, p. 30) of the inebriated gentleman who was bitten and, if we can believe it, "recovered without the slightest indisposition, but the poor *Heloderma*, not having been gradually immunized to alcohol, soon died from the noxious dose."

C. THE GILA MONSTER

The Gila monster (*Heloderma suspectum* Cope, 1869) is one of two species in the genus, the only genus in the Helodermatidae, one of the nine families of lizards found in the United States. This species is confined almost entirely to Arizona, though it does occur in adjacent territory in all of the neighboring states and Sonora. The only other species, *H. horridum* Weigmann, 1829, the type of the genus, first described (in popular language) by Hernandez (1615) occurs in central Mexico in similar habitats. It becomes somewhat larger, almost thirty inches long (Arrington, 1930, p. 30), and is known variously as Sonoran beaded lizard, crust lizard, and "escorpion." Its structure and venomous qualities seem to be not significantly different from the Gila monster. Though the ranges of the two are widely separated, Cope (1869) was the first to recognize the Gila monster as a separate species, it having previously been included in *H. horridum*. Bogert and Martín del Campo (1956) have recently divided the two species into a total of five subspecies.

Published records of Gila monster measurements indicate that the length of the specimen described above, 18 inches, is typical of adult individuals. Most authors state that it is known to reach two feet in length. At the time of hatching, the young are $3\frac{1}{2}$ -4 inches long. Arrington (1930, p. 35) reports that they are $6\frac{1}{2}$ inches long at the end of the first year, and Tinkham (1956) cites a year-old specimen as $8\frac{1}{2}$ inches long. In captivity they have reached an age of 24 years (Crossman, 1956).

Most of the upper surface of the animal is covered with tubercles, due to the presence of osteoderms in the skin, giving rise to the name "beaded lizard." Typical reptilian plates are found on the ventral surface of the abdomen and of the tail. The color pattern is mottled black and vermillion.

The animal is generally sluggish and slow. Bogert (1956) states that its maximum speed is 0.8 miles per hour. Ordinary handling seems not to aggravate it, but if angered, or exposed to direct sunlight, it can move suddenly, especially to swing its head in a lateral direction. Food observations in nature are few, but they apparently feed largely on the eggs and nestlings of birds and reptiles, and also on small mammals. Arrington (1930, p. 32) reports that in captivity they will kill rattlesnakes.

The teeth are short, rather deeply set into the fleshy gums, and also weak, breaking easily. Almost all of them are grooved, with a deep channel on the anteromedial surface, and, in the lower jaw, often a weak groove on the posterior side. Swellings on the outer side of the middle of the lower jaw indicate the presence of the large, elongated (2 cm.) labial glands which produce the poison. There is one set of four glands normally on each side of this jaw. Van Denburgh (1898, p. 214) states: "They vary in number because of the occasional union of the first and second glands, or the presence, posteriorly, of a small isolated ductless portion." The ducts from the glands are directed forward, opening near the base of the four anterior teeth on each side, between the gums and the lips, such that, in occlusion, the upper teeth tend to fit into the widened orifices of the ducts. Perhaps it was a misinterpretation of Cope's comparison (1882b) of *Heloderma* venom with that of the opisthoglyph snakes that gave rise to the erroneous impression, found in much subsequent literature, that it is the posterior teeth of *Heloderma*, rather than the anterior, which are associated with the venom.

In biting, the animal tends to clamp its jaws tightly, and may retain its grasp for ten minutes (Ditmars, 1933, p. 90) or even fourteen (Arrington, p. 30) without relaxing, but this is hard to determine, as it may relax barely enough to move its jaws slightly, securing another grip with a slight chewing motion. There is a tendency, when biting, to turn over on its back, though Arrington (p. 33) claims that gravity is a negligible factor in assisting the venom

into wounds. In general, the venom seems to be absorbed easily, being drawn into the wounds by capillarity. After the monster has bitten, it is extremely difficult to force it to relax enough to remove it from the wound.

Heloderma is the only genus of lizards known to be venom-producing. The Bornean earless lizard, *Lanthanotus borneensis*, in the related family Lanthanotidae, has been reported to be poisonous, but the teeth have no traces of grooves, and no other evidence suggests it, though no living specimen of this genus has reached America or Europe for study (Loveridge, 1946).

D. SYMPTOMS OF HELODERMA POISONING

The papers listed in the bibliography describe 24 cases of people being bitten by Gila monsters. Of these, 7 were followed by death, 8 involved more-or-less severe local and general symptoms but resulted in apparently complete recovery in a few weeks, 8 were followed by no appreciable symptoms at all, and 1 (mentioned incidentally by Viaux, 1939) was given with no comment. An analysis of these cases is given below. (Unfortunately Stebbins, 1954, p. 306, does not give the details of his reported 136 cases of poisoning, of which 29 were reputedly fatal.) However, in none of these cases described is there any measure of the amount of venom injected, certainly a critical factor.

The 7 fatal cases are as follows:

1. Arizona old settler (Edwards, 1924). Death "proved . . . due to chronic alcoholism."
2. Cowboy, 1886, Tombstone (Tinkham, 1956). Drunk; death in a half-hour.
3. Arizona old settler (Edwards, 1924). Probable cause: "heart failure from extreme fright."
4. Arizona hunter (Bogert, 1956). Died in a few hours.
5. L. M., Los Angeles, 1915 (Storer, 1931). Death in 52 minutes.
6. Arizona, between 1929-1951 (Klauber, 1956, p. 809). No data given.
7. Recent, near Tucson (Arrington, 1930). Death in three hours.

Case 5 is the only one with sufficient documentation to be seriously discussed. It is even possible that the other six may represent actually only three cases, i.e., case 1 and 2 may be the same, as may 3 and 4, and, similarly, 6 and 7. With regard to case 5, it might be significant to note that the individual had been bitten by Gila monsters before, and thus there is the possibility that he may have become sensitized to the venom, such that his fatal reaction was actually an allergic one. There are numerous cases, possibly similar, of people dying from a single bee sting, which involves a type of venom not usually considered fatal.

If an attempt were made to determine the attitudes of the people who have written up various aspects of *Heloderma* poisoning, they

might be divided into three classes: (1) those who feel it is not fatal to man, nor particularly dangerous, (2) those who feel it is very dangerous, and, at times, fatal, and (3) those who are noncommittal. While this is admittedly difficult to do, and possibly unjust, in class (1) could be placed Cope, Yarrow, Shufeldt, Garman, Loeb, Vorhies, and Essex; in class (2) might belong Bocourt, Mitchell and Reichert, Van Denburgh, Phisalix, Arrington, Ditmars, Stebbins, Bogert, and Tinkham; and in class (3) Engelhardt, Storer, Viaux, Smith, and Klauber. (The arrangement in each class is chronological). In summary, the question of whether Gila monster bites are fatally poisonous to a "normal" human being is still an open one.

Next are given the 8 less serious cases of poisoning, arranged with reference to the amount of clinical data available, from most to least:

8. Grant, 1956 (Present paper). Symptoms lasting a few days.
9. Tinkham (Tinkham 1956). Symptoms lasting two weeks.
10. Arrington (Arrington, 1930). Symptoms remained for two days.
11. Shufeldt (Shufeldt, 1882). Symptoms for three days.
12. An acquaintance (Viaux, 1939). Symptoms for five days.
13. Museum attendant (Engelhardt, 1914). Took two weeks to recover.
14. Phisalix (Phisalix, 1922). Local and some general symptoms.
15. Boy, age 14 (Arrington, 1930). Swollen arm.

For the first six of these cases (cited by number below, with the addition of names of authors who record the symptom but do not list specific cases), it is possible to compare the symptoms, arranged in order of frequency of report.

a. Edema: 8, 9, 10, 11, 12, 13, Langmann, Stebbins. This unanimity is in direct contrast to the almost total lack of local symptoms reported in experimental animals when the venom is injected with a hypodermic needle. Apparently the mutilating action of the teeth is a factor in the production of swelling.

b. Severe pain: 9, 10, 11, 12, 13, Langmann, Stebbins. Case 8 seems to be the only one in which pain was unimportant.

c. Cyanosis around the wound: 9, 10, 12, 13. Also, fatal case No. 5 was accompanied by a generally cyanotic condition.

d. Faintness or dizziness: 8 (mild), 9, 11, 13.

e. Profuse perspiration: 8 (mild), 11, 12.

f. Nausea: 9 (with vomiting), 12, Stebbins.

g. Profuse bleeding: 8, Stebbins.

h. Dyspnea: 9, Stebbins.

i. Slight paralysis: 10, Stebbins.

j. Neutrophile change: 8 (decrease), 9 (increase).

k. Lymphocyte change: 8 (increase), 9 (decrease).

l. Miscellaneous: Each recorded by only one of the authors: shock 11, increased heart action 10, chills and fever 12, pallor 12, red streaks on the upper arm 9, lumps on the side of the tongue 9, bulg-

ing eyes 12, slight dysphonia 9, seeing of blinding lights 9, numbness—Bogert, hypersecretion of the glands—Bogert.

There are left, then, perhaps 8 cases in which no appreciable symptoms followed the bites of the Gila monster:

- 16-18. Horan (Shufeldt, 1882). "Received on several occasions slight bites from these specimens, but the wounds were never followed by any untoward symptoms."
19. An alcoholic (Edwards, 1924). "The man recovered without the slightest indisposition."
- 20-23. L. M. and two others (Storer, 1931). "Both he and two or more of the witnesses had been bitten by Gila monsters previously but none of them had ever suffered any great inconvenience by reason of the bites."

SUMMARY

A clinical description is given of a comparatively mild case of toxemia resulting from the bite of an adult captive Gila monster (*Heloderma suspectum*). Symptoms and laboratory findings are presented in detail, perhaps as much so as in any previous case. An analysis of 24 available previously-published accounts of people who have been bitten by this animal is presented. Symptoms are tabulated and compared. The question as to whether Gila monster bites can be fatally poisonous to a "normal" person is still left an open one.

ADDENDUM

Since the above was written, Bogert and Martin's very comprehensive paper (1956) has become available, in which are cited 34 numbered cases of bites from Gila monsters. An attempt at identification of their reported cases (here cited by number as BM cases) with those listed above (GH cases) follows, with the BM case number given first, and the GH number following: BM 1, GH 1; 2, 16-18; 3, 11; 4, 2; 10, 4; 14, 13; 16, 14; 17, 5; 18, 7; 20, 15; 21, 10; and 27, 9. Case GH 3 is not specifically identifiable with any BM case, confirming the suspicion expressed above that GH 3 and 4 are the same case. In BM is an extensive bibliography of 445 titles, but the reference on which GH is based is not cited there. Similarly, the BM data seem to affirm the suggestion that GH 7 and 8 are the same case. Case GH 12 is not listed among GM's 34 cases, though the paper on which it is based is in the GM bibliography.

In addition to the ones reported in the present paper, BM cite three other fatal cases (GM 5, 8, and 9), though for BM 5 there is no first-hand account, and the other two are reported anonymously. BM also cite a dozen less serious cases, with symptoms lasting from a few days to a few months (BM 6, 12, 19, 24-26, 28-33), five more followed by no appreciable symptoms (BM 7, 11, 13, 22, and 34),

and two with no comment as to the outcome (BM 15 and 23). A few of these are well-documented with clinical notes (e.g., Shannon, 1953), but two are reported anonymously (BM 11, 34), two are second-hand accounts (BM 12, 25), and two are based entirely on newspaper clippings (BM 23, 24). Three are based on previously unpublished letters (BM 19, 31, 33). In five of the cases more serious symptoms were prevented by the fact that the person was bitten through at least one thickness of cloth or leather (BM 13, 29, 31, 33, 34).

Bibliography

- Arrington, O. N. 1930. Notes on the two poisonous lizards with special reference to *Heloderma suspectum*. *Antivenin Inst. Amer. Bull.* 4:29-35.
- Bocourt, F. 1875. Observations sur les mœurs de l'*Heloderma horridum*, Wiegmann, par M. F. Sumichrast. *Acad. Sci. Compt. Rend.* 80:671-679.
- Bogert, Charles M. 1956. The world's only venomous lizards. *Anim. Kingd.* 56:105-109.
- ; Martín del Campo, Rafael. 1956. The Gila monster and its allies. *Amer. Mus. Nat. Hist. Bull.* 109(1):1-238.
- Brown, W. H.; Lowe, Charles H. 1954. Physiological effects of labial gland secretion from *Heloderma* upon *Heloderma*. *Amer. Jour. Physiol.* 177:539-540.
- Buckley, Eleanor E.; Porges, Nandor; eds. 1956. *Venoms*. Amer. Assn. Adv. Sci. Pub. 44. 467 pp.
- Cope, E. D. 1869. (*Heloderma suspectum*.) *Acad. Nat. Sci. Phila. Proc.* 21:4-5.
- . 1882a. *Scientific News. Amer. Nat.* 16:842. (This note is unsigned.)
- . 1882b.. Note on the preceding paper by the editor. *Ibid.* 16:908-909.
- Crosman, Arthur M. 1956. A longevity record for Gila monsters. *Copeia* 1956: 54.
- Ditmars, Raymond L. 1933. *The reptiles of the world*. 2nd ed. N. Y.: Macmillan. 321 pp.
- . 1936. *The reptiles of North America*. Garden City: Doubleday-Doran. 476 pp.
- Edwards, Charles L. 1924. The Gila monster. *Nature Mag.* 4:26, 30.
- Engelhardt, George P. 1914. Notes on the Gila monster. *Copeia* No. 7:1-2.
- Essex, Hiram E. 1945. Certain animal venoms and their physiologic action. *Physiol. Rev.* 25:148-170.
- Fillmore, R. S. 1941. The early local treatment of snake bite. *Texas State Jour. Med.* 37:311-313.
- Garman, S. 1890. On the "Gila monster." *Essex Institute Bull.* 22:60-69.
- Hernández, Francisco. 1615. *De la naturaleza, y virtudes de las plantas y animales que estan receuidos en el uso de medicina en la Nueva España*. Mexico City: Daualos. 203ff. (Not seen.)
- Jackson, Dudley. 1927. First aid treatment for snake bite. *Texas State Jour. Med.* 23:203-209.
- Klauber, Laurence M. 1956. *Rattlesnakes*. Berkeley: Univ. Calif. Press. 2 vols. 1530 pp.
- Langmann, Gustav. 1913-1917. In A. H. Buck & T. L. Stedman, *A Reference Handbook of the Medical Sciences*, 3rd d. N. Y.: Wood. 8 vols.
- Loeb, Leo. 1913. The venom of *Heloderma*. *Carn. Inst. Wash. Pub.* 177. 244 pp.
- Loveridge, Arthur. 1946. *Reptiles of the Pacific World*. N. Y.: Macmillan. 259 pp.

- Mitchell, S. Weir; Reichert, Edward T. 1883. A partial study of the poison of *Heloderma suspectum* (Cope). *Med. News* 42:209-212.
- Mitchell, S. W. 1889. The poison of serpents. *Century Mag.* 38:505.
- Phisalix, Marie. 1922. *Animaux venimeux et venins*. Paris: Masson. 2 vols. 1520 pp.
- Pollard, C. B. 1956. Venom research, a challenge to the various sciences. In Buckley and Porges, *Venoms*, AAAS Pub. 44:5-8.
- Shannon, Frederick A. 1953. Case reports of two Gila monster bites. *Herpetologica* 9:125-127.
- . 1956a. Snake bite. Pp. 588-589 in Howard F. Conn, *Current Therapy*. Phila.: Saunders. 632 pp.
- . 1956b. Comments on the treatment of reptile poisoning. In Buckley and Porges, *Venoms*, AAAS Pub. 44:405-412.
- Shufeldt, R. W. 1882. The bite of the Gila Monster (*Heloderma suspectum*). *Amer. Nat.* 16:907-908.
- . 1891. The poison apparatus of the *Heloderma*. *Nature* 43:514-515.
- Smith, Hobart M. 1946. *Handbook of lizards*. Ithaca: Comstock. 557 pp.
- Stahnke, Herbert L. 1953. The L-C treatment of venomous bites and stings. *Amer. Jour. Trop. Med. & Hyg.* 2:142-143.
- Stebbins, Robert C. 1954. *Amphibians and reptiles of western North America*. N. Y.: McGraw-Hill. 528 pp.
- Storer, Tracy I. 1931. *Heloderma poisoning in man*. *Antivenin Inst. Amer. Bull.* 5:12-15.
- Tinkham, Ernest R. 1956. The deadly nature of Gila monster poison. In Buckley and Porges, *Venoms*, AAAS Pub. 44:59-63.
- Tyler, Albert. 1946. On natural auto-antibodies as evidenced by anti-venin in serum and liver extract of the Gila monster. *Nat. Acad. Sci. Proc.* 32:195-201.
- . 1956. An auto-antivenin in the Gila monster and its relation to a concept of natural auto-antibodies. In Buckley and Porges, *Venoms*, AAAS Pub. 44:65-74.
- Van Denburgh, John. 1898. Some experiments with the saliva of the Gila monster. *Amer. Phil. Soc. Trans.* (n) 19:201-220.
- ; Wight, Otis B. 1900. On the physiological action of the poisonous secretion of the Gila monster (*Heloderma suspectum*). *Amer. Jour. Physiol.* 4: 209-238.
- Van Derburgh, J. 1922. *The reptiles of western North America*. Calif. Acad. Sci. Occ. Pap. No. 10. 2 vols. 1028 pp.
- Viaux, Frederic B. 1939. Monster of the desert. *New Eng. Nat. No.* 4:17-19.
- Vorhies, Charles T. 1917. Poisonous animals of the desert. *Ariz. Agric. Exp. Sta. Bull.* 83:357-392.
- Wiegmann, A. F. 1829. Ueber das Acaltetepon oder Temacuicahuya des Hernandez, eine neue Gattung der Saurer, *Heloderma*. *Isis* 22:624-629.
- Yarrow, H. C. 1875. Report upon the collections of batrachians and reptiles made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona during the years 1871, 1872, 1873, and 1874. *U. S. Surv. W.* 100th Meridian 5:509-584.
- . 1888. Bite of the Gila monster. *Forest and Stream* 30:212-213.

SCIENCE DEPARTMENT

IOWA STATE TEACHERS COLLEGE

CEDAR FALLS, IOWA